Duke Engineering & Services

Partitioning Interwell Tracer Test (PITT)

Technology Need:

The source of large groundwater contaminant plumes is often believed to be relatively small "zones" or "pockets" of Dense Non-Aqueous Phase Liquids (DNAPLs). To the detriment of cleanup activities, the location of these source areas is often poorly defined or unknown. Accurate delineation and quantification of subsurface DNAPLs has been a persistent challenge to environmental managers tasked with cleanup of contaminated sites. Conventional programs relying solely on groundwater sampling and soil borings often fail to accurately characterize subsurface DNAPL contamination.

Technology Description:

The Partitioning Interwell Tracer Test (PITT) is a method for determining the location and volume of residual DNAPL in the subsurface. The concept of PITT was originally developed for petroleum exploration to measure the saturation of oil in a formation. The PITT involves the injection of a mixture of benign compounds, know as tracers, into one or more wells. Since the tracers can be either gases or solutes, PITTs are applicable to both the vadose zone and the saturated zone. The tracers are extracted from other wells where the concentrations of the various compounds are analyzed with a portable on-line gas chromatograph. The relative concentrations of each tracer, measured at the extraction well, provides an indication of the location and amount of DNAPL between the wells. Certain tracer compounds pass through a DNAPL zone unretarded; these are known as non-partitioning or conservative tracers. Other tracers are retarded by the DNAPL; these are known as partitioning (non-conservative) tracers. The differences in the concentrations of the tracers at the extraction well due to this partitioning can be displayed graphically as tracer concentration curves (Figures 1 and 2). A zone that is free of DNAPL will show no separation between the individual tracer curves; the curves overlie one another (Figure 1). Differences, or separation, in the tracer concentration curves is indicative of the presence of DNAPL, as in Figure 2. Calculations based on the concentration curves are used to determine the amount of DNAPL present between wells.

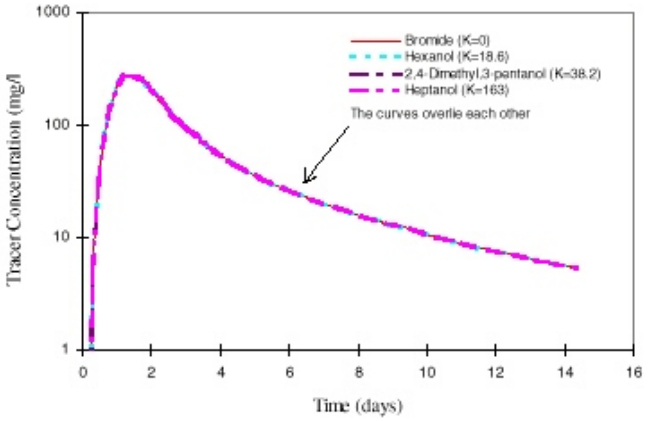

Figure 1: Example tracer response where no DNAPL is present.

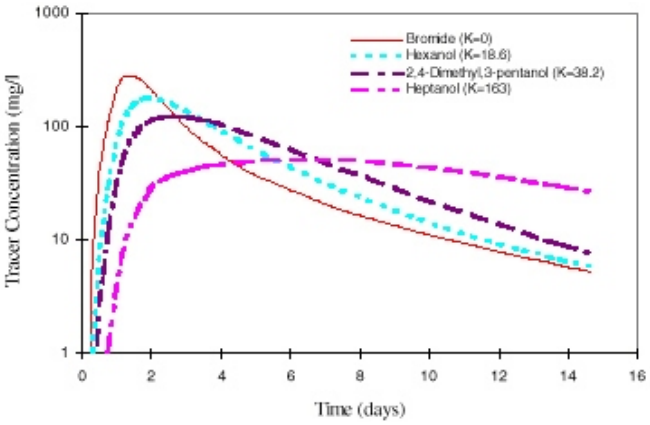

Figure 2: Example DNAPL response where DNAPL is present.

The PITT is the only technique currently available that provides an accurate idea of how much DNAPL is present in the subsurface. Using the PITT, as little as 3 gallons of Trichloroethylene (TCE) DNAPL has been detected in10,000 gallons of ground water. Since tracers can be either gases or solutes, PITT is applicable to both the vadose zone and the saturated zone.

The PITT can also be used to assess the effectiveness of remediation activities. Using the PITT both before and after remediation activities provides a measure of the change in DNAPL volume due to the remediation activity. This provides a quantitative assessment of the performance of a particular remedial measure.

Benefits:

- Only technique currently available that provides an accurate determination of the amount of DNAPL in the subsurface.
- Determines spatial distribution of DNAPL in the subsurface.
- Interwell method characterizes a large volume of the subsurface, minimizing undetected zones of DNAPL.
- Provides necessary information for design of effective remediation system.
- Applicable to both saturated and vadose zone characterization.

Status and Accomplishments:

This project was completed in 1997. The PITT method has been deployed at several DOE, Department of Defense (DOD) and commercial sites. A list of PITT deployments, with the date of the activity is provided below:

Sandia National Laboratory (95), Portsmouth Gaseous Diffusion Plant (96), USAF Plant 4, Fort Worth, TX (96), Kirtland AFB (97), PPG Chemical, LA (97), Chevron Cincinnati Facility (98), Marine Corp Camp Lejeune (98), Hill Air Force Base (96, 97, and 98), and OK Tools, NH (99) and the Pantex Plant (00).

Duke Engineering & Services has since been sold to Framatome ANP DE&S .

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 2963
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For additional information, please visit the Framatome ANP DE&S Internet website at http://www.framatomeanp-des.com/

The SEAR Technology Alliance Internet address is http://www.dnapl.com/publications.html